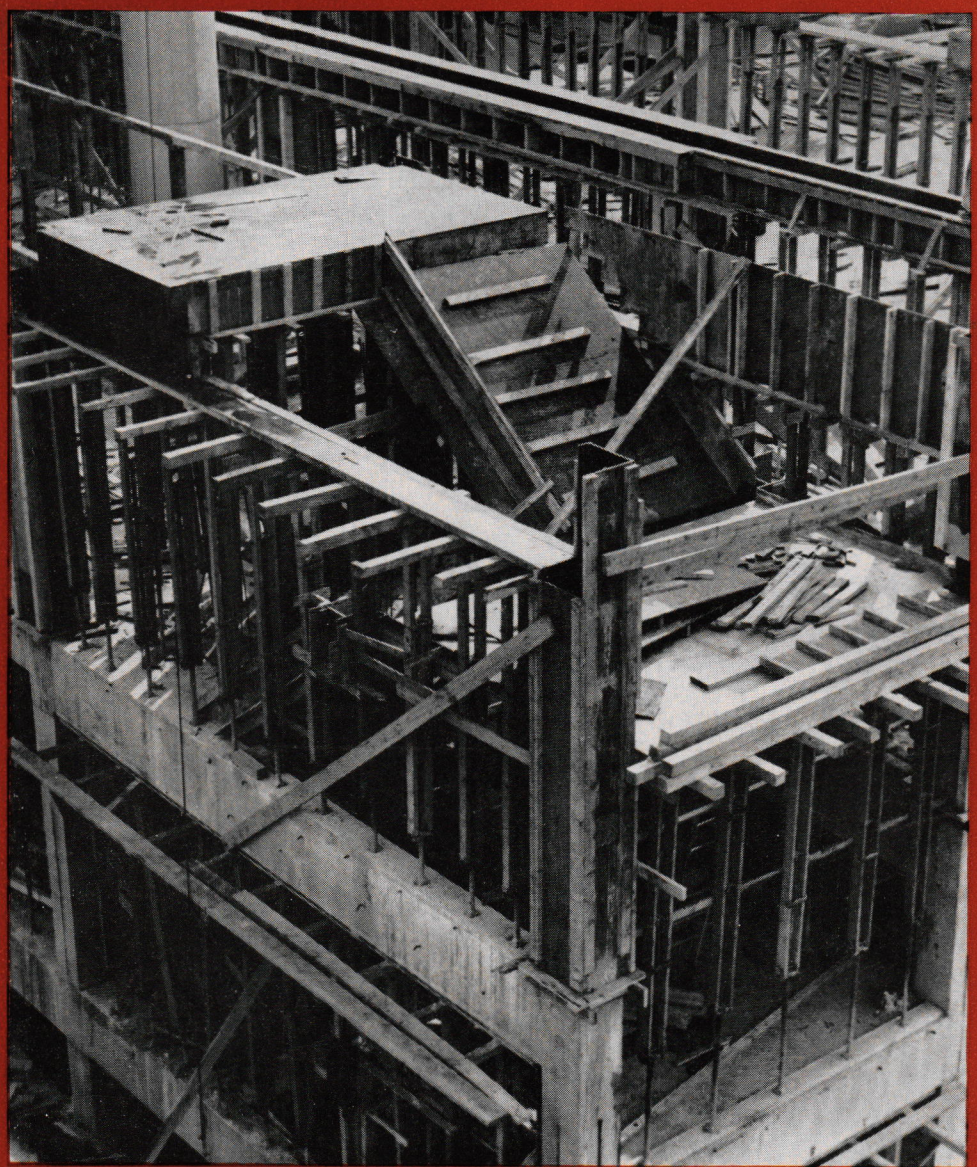
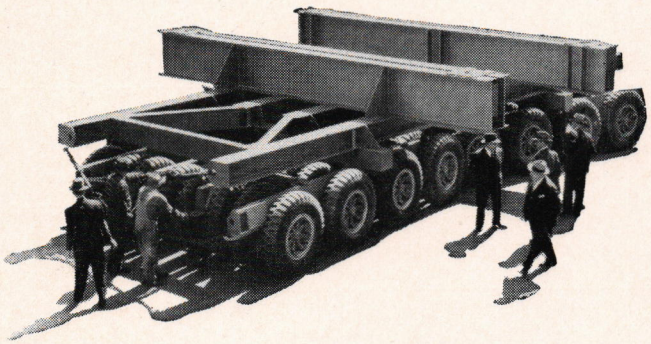
the Mechelecty

VOL. 10 APRIL 1951 NO. 5



THE SCHOOL OF ENGINEERING
GEORGE WASHINGTON UNIVERSITY

Another page for **YOUR BEARING NOTEBOOK**



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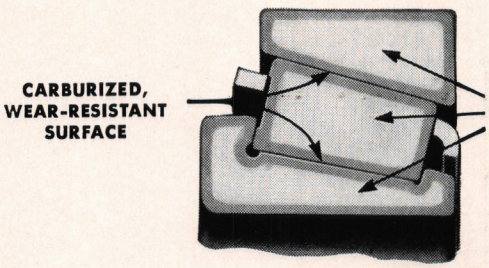

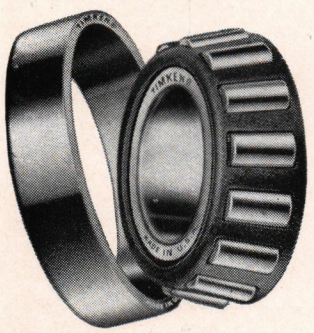

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"That's right.... *church closed"*

"No, this didn't happen in a communist country.

"Happened right here in town. We'd just gotten home from a motor trip and, of course, hadn't heard what happened.

"Been going to that church about fifteen years, so what a shock it was when Officer Povey stopped us at the door. *'That's right,'* he told us, *'I said church closed!'*

"*Then* he explained. There'd been a fire in the church the day before and he was shooing folks over to the Guild Hall for services. Mary and I looked at each other . . . then grinned. We'd *both* had the same crazy idea that the State had taken over the churches.

"That night Bill and Edna Johnson dropped in for TV. We told them what happened at the church. And about the crazy idea we had. But Bill asked, *was* it so crazy? Then he pointed out that it *had* happened in other countries. So we all got talking real serious.

"All week I've had it on my mind . . . *suppose we had no Freedom here?* Suppose the State took over religion, the press and professions like music, medicine and art? Suppose they took over industry and made me work where I didn't want to? Suppose the State took over our house? And suppose, on election day, we had our choice of *one* candidate?

"Maybe I don't run my life perfectly but I sure wouldn't want the State to run it for me! Y'know, every Thanksgiving we give thanks for the good things we have . . . all of which add up to Freedom. *So why shouldn't we all be just as thankful the* other *364 days, too?"*

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- ☐ Dynamics Engineer
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- ☐ Missile Test Engineer
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The MECHELECIV

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About our Cover

Shown is a portion of Monroe Hall, new classroom building under construction back of the Hall of Government on G Street between 21st and 22nd at the George Washington University.

ENGINEERING SCHOOL CALENDAR

April 1951

April 2—Monday—Engineers' Council meets, Conference Room, Student Union Annex.

April 4—Wednesday—ASCE, ASME, AIEE, and IRE meet in Hall of Government, 8:15 p.m.

April 11—Wednesday—Career Conference, Lisner Auditorium, 8:00 p.m. All classes excused for this All-University function.

April 16—Monday—Engineers' Council meets, Conference Room, Student Union Annex.

April 18—Wednesday—Sigma Tau meets, C-200.

April 21—Saturday—Sigma Tau Initiation, 1:00 p.m., Lisner Studios A and B; Banquet, Lee Sheraton Hotel, 6:30 p.m.; Dance, Lee Sheraton Hotel, 9:30 p.m.

April 25—Wednesday—Theta Tau meets, Room D-201, 8:15 p.m.

April 30—Monday—Engineers' Council meets, Conference Room, Student Union Annex.

. . . . taking stock

Although it may seem yet a little early in the year to undertake the evaluation of any organization, nevertheless, the Engineers' Council, by virtue of its accomplishments, has made itself worthy of consideration. In addition, most of the projects which can indicate its effectiveness have already passed.

The revision of the method of choosing delegates to the council in an important accomplishment, even if it seems rather simple now that we look back on it. The change was necessary without doubt, to assure some semblance of continuity of policy on the council independent of the election of delegates by societies. Almost everyone was in sympathy with this basic idea, but in the process of explanation to the societies, and of setting up the machinery, it was almost lost. Now that it is understood by all, however, its true simplicity is apparent; next year's representation will be partly veterans of this semester's council.

This project, in addition to the routine load of mixers, the dance, joint meetings, raffles, the banquet, the career conference, and the Christmas Tree, have kept the council busy and will continue to do so until the end of the year. It may be hoped, however, that another year, committee work will abbreviate discussion of routine matters, and leave time for consideration of important projects, a few of which will be mentioned here.

That project which brings the engineers more publicity than any other of the school year is the old standby, the Christmas Tree. Last Christmas, it was due to the efforts of a mere handful of faithful engineers (not all council members) that the tree project was completed at all. The three main divisions of effort necessary to this undertaking are the procurement, erection, and decoration of a tree. Since there will not always be enough interested and dependable students who can pull the council out of a tight spot, the two most difficult operations should henceforth be eliminated by the planting of a permanent Christmas Tree in an approved place in the yard. The cost of the tree is the largest obstacle here, but the money might be secured by a special fund-raising campaign, or the University might see fit to give aid through its landscaping funds.

A primary cause for poor attendance at any function, such as a society meeting, a mixer, or a dance, is the lack of contact of a personal nature. A student may see posters or hear announcements, but they will mean little unless he happens to be interested in the goings-on for some special reason. A postcard always helps to make the student aware that he is being personally asked to attend the function. Next year, the Mecheleciv will be mailed to all the engineering students on the campus. The same addressograph stencils which are used for this purpose could be used to great advantage for the mailing of society notices. Instead of reaching the limited number of engineers who had the courage to come to the previous mixer, the communication would reach every engineer in the school, according to the special branch he was studying. Assuming that the proper type of program is planned for each meeting, this system could easily double or triple the membership of the societies, while acquainting the freshmen with the functions of the council and the societies at a much earlier date.

Professor Norman B. Ames made a suggestion at the last mixer, concerning a memorial to the late Professor Arthur F. Johnson. Establishment of such a memorial by action of the council should be provided for before the end of this year. Some types of memorials previously established both in the Engineering School and elsewhere, are plaques and pictures. Of course, these are not the only possibilities, and some more suitable medium may well be found.

Next year's council, to become successful, need only remember the experiences of this year's, and thus spend the bulk of its time on the really important accomplishments.

Effects of Jet Aircraft on Airport Pavements

by Albert B. Moe, Lieut., USNR

Undergraduate in Civil Engineering

Airways Engineer, Bureau of Aeronautics, U. S. Navy

(This material has been released for publication by the U. S. Navy — Ed. Note.)

The recent trend toward jet propelled aircraft has imposed new and as yet unsettled problems in regard to the design of airport pavements. The military jet is the only jet plane in service at this time and it is the fighter type that is responsible for the majority of the problems involved at the present time. Airport pavements are mainly concrete (rigid) or bituminous (flexible) and the effects of jets on these two types of pavements are not the same. The effects also differ on various sections of the pavements depending on the status of the airplane on that particular section, i.e., whether the plane is standing, taxiing, landing, warming up, or taking off.

Since high speed is desired in a fighter, airfoil sections must necessarily be small and thin. Accordingly, the space dedicated to landing gear stowage is at a premium, necessitating a compact gear with small wheels and tires, with correspondingly higher tire pressures.

New design criteria are necessary for the successful development and construction of pavements for jet fields and new experiments, tests, and equipment are needed to establish the required criteria.

Due to the great cost involved in the development of new type aircraft, the government is the only user that can afford to provide the large sums of money required. Since military preparedness is a necessity, it is natural that the military plane be the type chosen to "carry the developing ball." Military jet aircraft includes bombers weighing over 200,000 pounds and tough little fighters weighing around 10,000 pounds.

A Navy fighter, the Vought Cutlass, F7U, is a good example of the type of jet plane having the most deleterious effects on airport pavements. The long oleo

Official U. S. Navy photo showing blast damage on airport pavement.

Official U. S. Navy photo showing another view of airport pavement damaged by jets.

strut of the nose wheel gear causes the center line of the plane to make a rather large angle with the ground, thereby permitting the hot exhaust gases to impinge on the pavement close to the tail pipe. Thus, the effects of high temperature and blast are combined to give the pavement a treatment beyond that for which it was designed.

It may be well at this time to again call attention to the fact that the problems involved in airport pavement design are completely different for each type of pavement concerned and are, except for a very few exceptions, not related. For instance, rigid pavements, thick enough to support the maximum size of plane to be stationed at a field, are little affected except for the joints and joint material required to fill them. No satisfactory joint material has been marketed to date which can stand the temperature and blast from a jet engine.

Flexible pavements, however, present different problems, most of them difficult to solve. The small high pressure tires have a more deleterious effect on a flexible pavement than larger low pressure tires carrying a higher wheel load. This effect carries through to the binder courses and subgrade. Therefore, criteria must be established for pavement thickness, density, stability, and subgrade materials.

Fuel spillage dissolves asphalt but appears to have only short-lasting effects on tar. Heat, however, is the conquering element, and, like the joint material for rigid pavements, no flexible pavement today can stand up under the heat and blast of the jet engine.

Problems peculiar to jet aircraft only have been listed so far. In addition to the above, the loading of an airport pavement is dependent on the status and attitude of the airplane itself. For instance, impact is not considered in the design of a runway since it has been assumed, and with reasonable accuracy, that part of the weight of a plane is borne by the wings until forward motion has ceased. Accordingly, the full weight of the plane is not transferred to the pavement immediately upon landing nor is the full weight of the plane supported by the runway during taxiing.

A plane standing without the engine running imposes the greatest loading condition on a pavement and therefore the static load on the pavement equals the gross weight of the aircraft. For this reason, pavements designed for static loads will be sufficient for all conditions of loading.

The design of an airplane, governed by its assigned mission, greatly affects pavement design, not only by the weight of the plane but by the tire size and the

(Continued on page 18)

Capacity Controlled Relays

by Charles C. Gager, Jr.
Undergraduate in Electrical Engineering

In highly complicated modern equipment installations, motors, counting devices, hydraulic valves, etc., can all be controlled with a device known as the electrical relay. The action of this relay is controlled by the current flowing through the relay coil and some device must be used to control this current. The simplest and most common device is the mechanical switch which will open and close the electrical circuit of the relay. This switch requires physical contact with the object which is to open and close the switch, whether it be the human hand or some object on a conveyor belt. In many instances it is impossible to have the object, which is to control the relay, make physical contact with a switch. In these cases, it is necessary to resort to other devices such as the photoelectric controlled relay, radioactivity penetration for measuring thickness, and the capacity-controlled relay.

The capacity-controlled relay, as the name implies, is a device that will perform the desired "off" and "on" snap action simply by sensing a change in capacity or, to be more exact, by sensing the change in the dielectric in some certain volume of space. The unit consists of three parts: the sensing device or capacitor whose dielectric is to be changed, the associated electronic circuits which convert this change of capacity into a controlling current, and the relay whose action is to be controlled.

Starting at the back and working forward we find the relay which usually consists of the conventional mechanical switch which is activated by an electromagnetic coil. This type of relay would be used where the "off" and "on" snap action is desired. For a continuous control tyratrons might be used.

Next comes the electronic circuits which are able to sense the slight change in capacity and turn this change into a controlling current or voltage to control the relay. There seems to be four basic types of circuits for accomplishing this purpose. The first and probably the simplest and most popular consists essentially of radio frequency oscillator and associated amplifiers. The sensing element or capacitor whose capacity is changed is so connected as to control the amplitude of the oscillations of the radio frequency oscillator by changing the amount of regenerative feedback voltage. Then the radio frequency output voltage is rectified and amplified to control the relay.

Another type relay is the one that employs a radio frequency oscillator which is crystal controlled. The oscillator is so designed that it operates on the tank capacitance-plate current curve at a point where a small change in the sensing capacitor which shunts the tank circuit is sufficient to cause a large change in the plate current of the oscillator. The relay is placed in the anode supply circuit and this change in current will actuate the relay.

A more sensitive, but more complicated circuit consists of two radio frequency oscillators having the same frequency of oscillations. These two oscillators are link-coupled by an electronic current sensitive circuit. The sensing capacitor is connected across the tank circuit of one of the oscillators and a small change in the capacity will tend to change the frequency of the oscillator. As the frequency of the oscillator tends to change, a current will flow through the link between the oscillators to try to bring them back in synchronism. This current is amplified and is used to control the relay.

The last and probably the most sensitive type of capacity-controlled relay also employs two radio frequency oscillators. In this circuit the two oscillators are adjusted to two different frequencies and then their outputs are mixed together to produce an intermediate of difference frequency. This action is similar to the everyday superhetrodyne receiver in which the incoming signal of one frequency is mixed with the signal from the local oscillator to produce the intermediate frequency. This new intermediate frequency is then passed through a series of tuned circuits and amplifiers which will be very selective and discriminate against any change in the intermediate frequency. The sensing capacitor is then connected across the tank circuit of the highest frequency oscillator. As the capacity of the sensing capacitor is changed by a slight amount, the frequency of the oscillator will be changed; so as the two oscillators are beat together, the intermediate frequency will experience a change in its frequency. This change in frequency will produce a change in the output of the amplifiers and this in turn will control the relay. This circuit is very sensitive due to the fact that a certain change in the oscillator frequency will produce the same change in the frequency of the intermediate frequency, but since the intermediate frequency is much lower, the change in frequency will be a much larger proportion of the original frequency than it was in the oscillator. The intermediate frequency is

(continued on page 19)

Moving Target Indication for Radar

by Frederick H. Battle, Jr.

Undergraduate in Electrical Engineering

The advantage of eliminating fixed target signal indications in a radar system used primarily for the detection of moving targets, such as aircraft, is based upon two undesirable effects of their presence: the fixed target signals are likely to saturate the indicator where they occur, hiding superimposed target signals; and the appearance of many fixed targets is quite similar to that of moving targets as presented on the indicator, so that quick and positive distinction is possible only after the fixed pattern has been memorized. It is therefore desirable to provide for automatic elimination of fixed targets within the equipment.

Suppose an antenna to be designed so that it could be instantaneously converted to a non-radiating tuned circuit of high Q, without upsetting the electrical length in any way. Now suppose that a pulse of RF from a radar transmitter is fed into the antenna, but after half the duration of the pulse the conversion to a tuned circuit is made. Then some radiation will have occurred, after which a damped oscillation having the same phase angle will be set up by the last half of the pulse. If the radiated wave train is reflected by a target and returns while the damped oscillations continue, there will be, in general, some phase difference between the two; the exact angle of phase difference is a function of the delay introduced by propagation to and from the target; i.e., the phase angle is a function of target distance. If the process is repeated with a second pulse, reflection from the same target will result in the same phase angle, provided that the target distance has not changed; if the distance has changed, as with a moving target, the phase angle will also have changed.

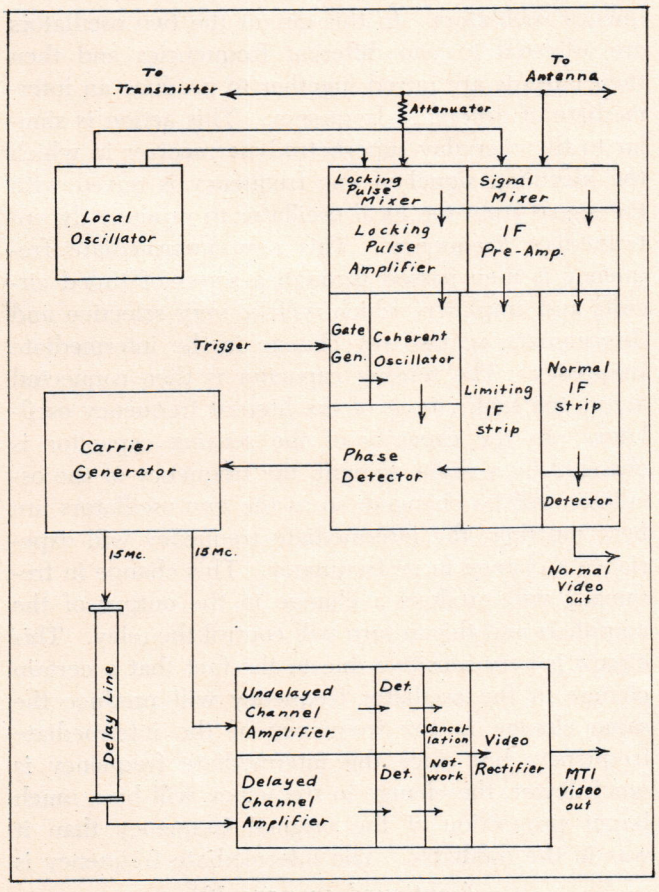

Figure 1

This change of phase angle with time, peculiar to moving target echo signals, might be used to distinguish between fixed and moving targets, if a practicable system were devised for holding a reference phase and making the necessary phase comparison at short intervals.

In order to distinguish between radar signals returned by fixed objects, or targets, and those returned by targets which are moving relative to the radar station, detection must be made of some distinctive property of the returned signal which ordinarily results only from such relative motion. In the conventional radar system, incorporating no automatic means of moving target delineation, the utilized properties of moving target signal returns are the gradual changes in direction of propagation and elapsed time between transmission and reception; the vector combination of these two changes results in a continuous change in position coordinates on the indicating system. This method of moving target distinction, although widely and successfully used by experienced operators, is subject to two inherent disadvantages: fixed targets are not removed from the indicator, which permits confusion and possible obliteration of moving targets; and an appreciable time lag is required for the distinction to be made.

If an automatic system of moving target indication is to introduce any considerable advantage, it should overcome the above two difficulties; i.e., fixed target indications should be removed, or greatly attenuated as compared to the desired indications, and the time lag involved should be made negligible.

The Doppler effect gives rise to properties of the returning signal which are both instantaneously de-

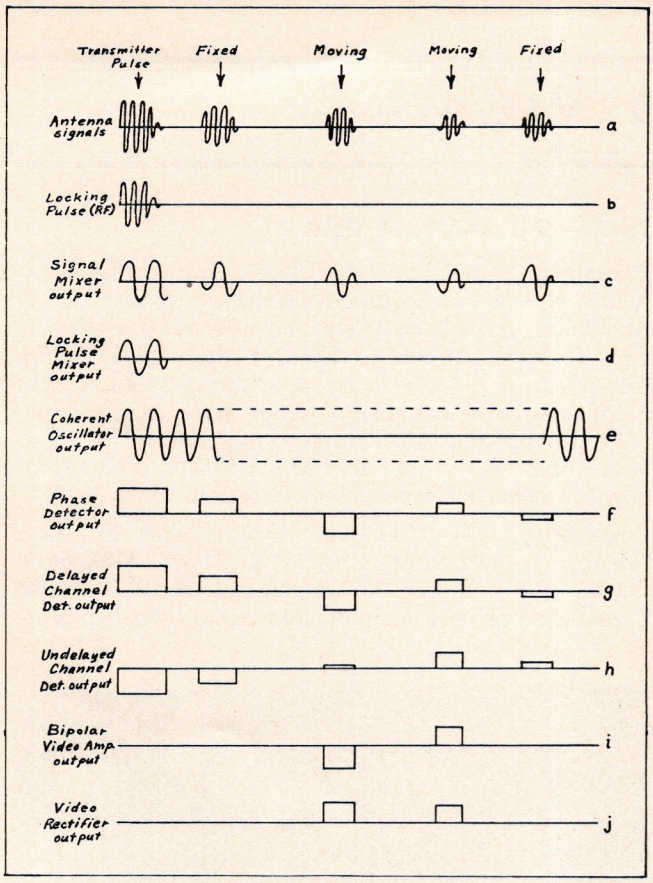

Figure 2

tectable and unique to moving target echoes. Assuming a target velocity having a constant component radial to the radar set, the returning radio-frequency wave, when compared to the emitted wave, will show a fixed difference in frequency and a continuous change in phase angle. While either of these properties might be detected, the frequency shift represents an extremely small percentage of the radio frequency used in a radar system, and thus requires a high order of sensitivity and stability in the detecting devices. On the other hand, the rate of change of phase angle in waves returned from a target having even a small radial velocity is sufficiently high that full 360° phase shift may occur in a matter of milliseconds, and some component of phase shift will always be an appreciable percentage of 360.°

In general, there will be some phase difference between the transmitter oscillations and each returned signal picked up by the receiving system, the exact phase angle in each case being determined by elapsed time, which is a function of target distance. For a fixed target, the elapsed time and the resulting phase angle are always exactly the same; for a target whose distance is changing, however, the phase angle relative to the transmitter phase also changes. Thus, if the phase difference between transmitted and received signals is periodically measured, only moving target returns will show any change in phase difference from one interval to the next.

The MTI (moving target indication) system to be described uses the "coherent phase Doppler" method of distinguishing moving target echoes, and is used in conjunction with the conventional pulsed radar transmitter. Since the RF wave train of any one pulse will have a random phase angle compared to the wave train of any other pulse, phase comparison between emitted and returning signals must be made within a single period of the pulse recurrence frequency, so that the phase of the echo signal is referred to the phase of the transmitter oscillations during the pulse which gave rise to that echo, rather than to the transmitter phase during any successive pulse. In order to permit echo signals to be received, however, the transmitter oscillations must have ceased, and hence no direct comparison between transmitter and echo phase angles is possible. For this reason, the transmitter phase is preserved during the receiving period between transmitter pulses by means of a separate oscillator which is triggered by a "locking pulse" derived from the transmitter pulse.

Actually, the phase comparison process is carried out at the intermediate frequency of 30Mc. The sys-

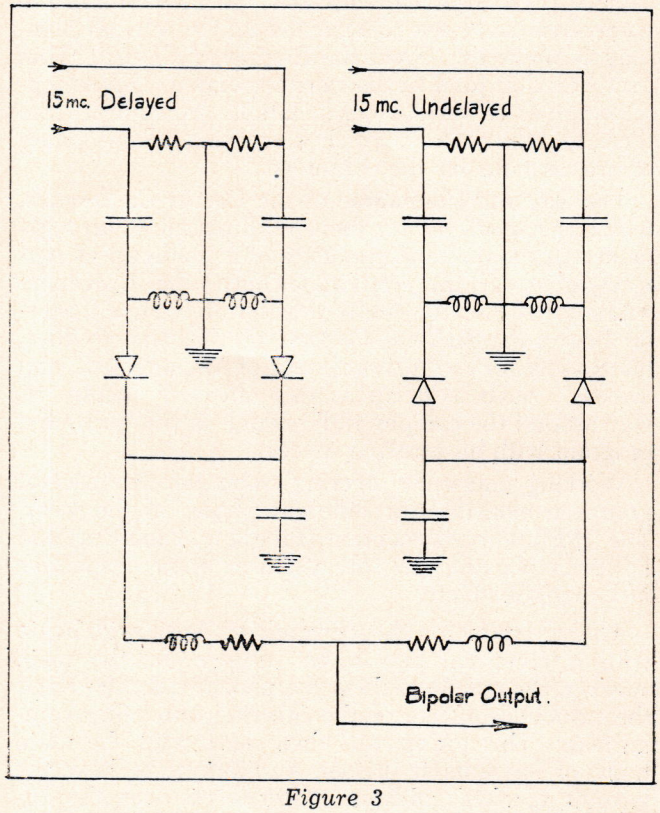

Figure 3

tem block diagram, Figure 1, indicates the method by which both the locking pulse and the target signal returns are converted to 30 Mc. The signal channel is conventional, with the echo signals passing from the waveguide transmission system to the usual crystal mixer, where a 30 Mc. heterodyne results from the addition of a local oscillator signal. Similarly, after suitable attenuation, a sample of the transmitter output (the locking pulse) is converted to 30 Mc. by

(continued on page 20)

NEWS AND VIEWS

RICKENBACKER TO SPEAK

Captain Edward V. Rickenbacker, outstanding American air ace of World War I, and President of Eastern Air Lines, will be the keynote speaker of the first annual career conference to be held at the George Washington University at 7:30 p.m. in Lisner Auditorium on April 11th. Mr. Glenn L. Martin, of the Martin Aircraft Company, is expected to address the Engineers' panel of the meeting, which will meet separately following the main meeting.

The Career Conference is an event which merits the interest of every engineer. The careful planning and hard work of the Conference organizers have resulted in something which promises to become a regular yearly event. Among the benefits derived by the students are the first hand information from leaders in the engineering field, and the opportunity to have individual questions answered.

Each division of the University participating in the conference has been represented on the various planning committees. From the Engineers' Council, Tom Mutchler and John Lewis were appointed. These representatives of various organizations are divided into three groups, each of which is working on one phase of preparations for the conference.

The Steering Committee of the Career Conference, which is responsible for the overall planning, arrangements, promotion and production, is made up of representatives of the Activities Office, the University Alumni, the Faculty, the Interfraternity Council, Mortar Board, Pan-Hellenic Council, the Placement Office, the Society for the Advancement of Management, and Tassels. Such a group as this obviously knows its way around the campus well enough to put on such a program with all possible success.

Working under the steering committee are several groups responsible for different phases of the work. The Hospitality, Reception, Program, Facilities, and Publicity Committees all perform their respective tasks independently.

The program for the eleventh of April will begin with a reception and buffet supper for the main speaker, the panel speakers, the panel moderators, and the principal officers of the Steering and other committees. This group will then meet with the main body of students in Lisner Auditorium to hear the keynote speaker's address. After this is over, the different occupational groups will repair to their meeting rooms to hear the comments of experts in their own fields. There will be a period of questions from students following this. Rounding out the conference, the speakers and students will all gather at the Student Union for coffee and doughnuts.

It is expected that classes on the night of April 11 will be excused for this meeting. There is nothing then, to prevent every engineer from attending and hearing the views of the leaders in the field. Announcements of the exact times and places of the various meetings will be forthcoming at a later date.

THETA TAU BANQUET HELD

Gamma Beta Chapter of Theta Tau held its sixteenth birthday banquet on Saturday, March 17, at the Hotel Burlington. The surprise of the evening was the presentation to Dean Feiker, an honorary Theta Tau, of a gavel, given in appreciation of the helpfulness and friendship which have long characterized his association with the engineers. This gavel is symbolic of the fact that Dean Feiker is the Honorary Regent of Gamma Beta Chapter.

Speakers at the affair were Dean Feiker, Professor "Deacon" Ames, and Merwin K. "Pop" McKnight. During the banquet the new members, Bob Burns, Fred Battle, Tom Flanagan, John Held, Herman Norwood, Carl Rose, Joel Sonnabend, and Bob Smith, were introduced to those present and each gave a short impromptu speech. These new men were initiated into the chapter Saturday afternoon.

Dean Frederick M. Feiker and Professor Norman B. Ames place pins on new members at ceremonies Saturday, March 17.

Following the banquet, a dance was held. During an intermission, the new members presented a skit for the entertainment of the other members and guests. After the skit, the award was presented for the best model of the Gear. Each member of every pledge class is required to construct a model of the Theta Tau pin which is in the shape of a gear. The best model of each group is chosen by vote of the active and alumni members. All of the models were excellent and after much deliberation, Bob Smith's gear was chosen as the outstanding one of the group.

All who were in attendance are looking forward to next year's banquet and dance. This affair continues to be, for Theta Taus, the outstanding social occasion of the year.

NEW COUNCIL KEYS DESIGNED

At its last meeting on March 19, 1951, the Engineers' Council discussed the findings of a special committee set up to investigate the present council key and possible redesign. As the report of the committee, chairman Tom Mutchler submitted a drawing of a hexagonal key, quite different from the present council key, which is trapezoidal and contains a relief of a rail section. The committee submitted this hexagonal design as a substitute for the present key. It is believed that when the cost of having this new design specially made is determined, it will be less than the price of the old key.

The significance of the hexagonal design lies in the fact that the Engineers' Council, the representative body of the students of the School of Engineering, is composed of delegates from six organizations. These organizations are the four Engineering societies and the two fraternities. In the center of the key is a symbol which is universally recognized as the mark of an engineer. A surveyor's transit, even to the layman, typifies that precision of measurement which characterizes all types of engineers.

Lettered in relief around the transit in the center, are the words "Engineers' Council," and the letters G W U. This completes the key. The design used in the form just described will probably have other applications later if the Council has need of it.

The key will be paid for by the Council, as is the usual procedure, and will be presented to those members of the council whose terms will expire in May. The delegates who were elected under the new system last February, and whose terms extend until next February, will not receive keys until then.

PARKING LOT NEARS COMPLETION

Houses have been razed on the block bordered by twenty-third, H, twenty-fourth, and I Streets to prepare for the 350 car parking lot to be operated by and for the University, and only one building remains to be demolished on the block. Space for 50 cars will have to be allotted on the new lot for the University Hospital parking since the present lot will have to be vacated to make room for the cancer research building to be erected shortly. However, there will be 300 spaces on the nearby lot for students and faculty.

University officials have said the surfacing of the lot is to be done with rolled bank gravel and three concrete driveways are already in place. The lot will operate from early morning, between 6:00 and 7:00 A.M. until approximately midnight. Lights will be installed for night operation. Adequate attendants will be employed to assure protection of the cars and that qualified parkers are using the spaces.

The University is still working on a plan to cover the cost of maintainance and another plan to insure a maximum turnover of cars. Officials of the University are very anxious to see that the spaces are used fairly.

MONROE HALL CONSTRUCTION PROCEEDS

Newest addition to the University campus, now under construction on G Street behind the Hall of Government, will be the James Monroe Hall, a building of classrooms and faculty offices. The new hall, to consist of four stories above the ground level, was started last fall by the Charles H. Tompkins Construction Company and will incorporate the existing heating plant structure below the ground level.

Monroe Hall, expected to relieve the present overcrowded conditions in some classrooms, will have faculty offices on the first and fourth floors; the basement, second and third stories will be devoted to classrooms. Its design will be similar to that of Buildings C and D with modifications.

This is the first building on campus to be named in honor of an American President. Construction is expected to be completed this year.

ENGINEERING JOBS OPEN

The University's Personnel Office has a number of very good positions for graduate engineers with varying amounts of experience. Some positions are also available for undergraduates. This is important to all engineers who expect to graduate in June, as well as to those who are interested in employment before then.

In order to assure each student of as wide a choice of positions as possible, the Personnel Office requests that interested parties go to that office, on the west side of twenty-second street, between G and H, and fill out a brief form. This enables the Personnel Office to keep those students informed of such openings as may now be available or will be available by June. It will be advantageous to interested students not to postpone this registration until June, when the selection of jobs may be less inviting.

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ALUMNEWS

Lewis J. Dawson, BSME '37, says that he was filled with horror to find we listed him as an EE in the December issue. We are sorry we erred, but at least we got a letter out of it, learning that Lewis is in Phillipsburg, New Jersey, with the Ingersoll Rand Company. He says he likes his job fine, and is a field engineer for the Cameron Pump Division of the company, heading up service work and trouble shooting. He also says that they have a couple of openings if any recent ME grads are interested.

William Wroblicka, BSE '49, writes from Pittsfield, Massachusetts, to tell us that he is with General Electric. He has spent three months on Power Transformer Test, and went off test in Distribution Transformer Design Engineering.

On Monday, March 18, the National Capital Alumni Association of Theta Tau Fraternity held a business meeting in the basement of the Hall of Government. The main concern of the meeting was the election of officers for the coming fiscal year. The results of the election are as follows: Chuck Myers, President; John Connor, Vice-President; Harold Thomasson, Secretary; Ervin J. Liljegren, Treasurer, and Howard Grayson, John McPhail, and Erving Ballou, Executive Committee members.

After having served their terms through a highly successful year, the retiring officers were given a vote of thanks by the members. Last year's officers were: Merrill Brown, President; Harold Thomasson, Vice-President; Chuck Myers, Secretary; Ervin J. Liljegren, Treasurer, and Bert Randell, Vincent Hennessy, and Erving Ballou, Executive Committee members.

The present membership rolls of the National Capital Alumni Association of Theta Tau contain some one hundred names. The incoming officers believe that this number, which is by no means small, can be boosted even higher with the help of the present members of the Association, and of this column. Any Theta Tau alumni reading this column who have not registered with the Alumni Association are urged to do so, by contacting the Secretary, Harold Thomasson. Mr. Thomasson's address is 1401 North Taft Street, Apartment 10, Arlington, Virginia.

One of the projects contemplated for the ensuing year by the Theta Tau Alumni is the compilation of an alumni directory. Included in the list in addition to the names will be the present address, telephone number, and place of employment. The fee for a listing will be in the neighborhood of one dollar.

Some of the alumni present at the Theta Tau gathering were *John Connor*, BEE '50, and *Al Craft*, BEE '50, both working in the sales division of the Alexandria Building Supply Co., Inc.; *Howard Grayson*, BME '50, who is oddly enough employed by the Washington heating contracting concern of H. R. Grayson and Son; *John McPhail*, BEE '50, last year's president of the AIEE, now working for McGregor and Werner, Inc., electrical engineers, and *William Whittemore*, BEE '50, former president of the Engineers' Council, who is still working for the Brush Development Company.

Also present were *Harold Thomasson*, BEE '48, employed as a television engineer by station WNBW, of the National Broadcasting Co.; *R. L. Fenton*, BME 47, part-time faculty member, and mechanical engineer at the Bureau of Aeronautics; *Don D. Blanchard*, BCE '49, the University's Business Manager; *E. W. Pritchett*, BME '48, also a mechanical engineer at the Bureau of Aeronautics; *H. H. Murray*, BME '48; who is working at the Patent Office of the Department of Commerce; *M. R. Brown*, BCE '49, now working at the Army Map Service; *George Kilpatrick*, BCE '45, who is with the Civil Aeronautics Authority, and *Ervin J. Liljegren*, BCE '49, now at the National Institute of Health, in Bethesda, Maryland.

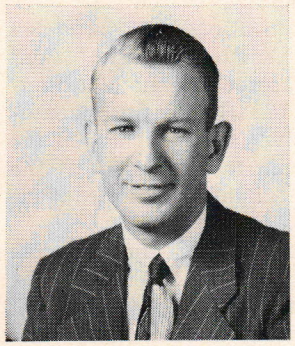
Sol Fineblum, BME '50, writes from San Diego that he thinks he has a good deal there with Consolidated Aircraft as a Junior Engineer in General Design. Send us more scoop on it, Sol.

Bob Spitler tells us that the latest about *John Kline*, BEE '50, is that he is now employed as an electronic engineer at the Naval Research Laboratory.

A recent suggestion which the editors of this magazine received is that some of the alumni organizations in Washington such as The Engineers' Club, and the National Capital Alumni Association of Theta Tau, might be interested in supplying material for the alumni page. The main object of the column, of course, is to print information about individual alumni which we hear or receive through the mail. If, however, any organizations wish to send in material, it will be gladly received. The address is The Mecheleciv Magazine, Student Union Annex, The George Washington University, Washington 6, D.C.

ENGINEERING PERSONALITIES

UNDERGRADUATE



A man of many and varied talents, the current treasurer of the senior class is an experienced lens polisher, electrician, naval fire control expert, estimator and will soon qualify as an electrical engineer. James Hampton was born in Kansas City on February 4, 1924. Until he reached high school his only exciting experience, according to Jim, was falling off a high wall and fracturing his skull, from which he claims he subsequently recovered.

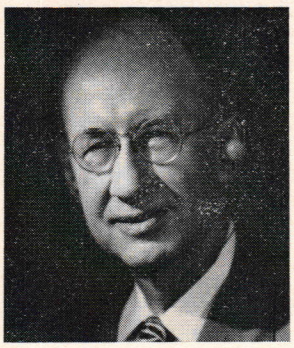
In East High School in his home town, Hampton was a leader in student activities, holding at one time the presidencies of the Student Council, Spanish Club, and Hamilton Literary Society. Before graduating in 1941, Jim also participated in cheerleading and won the sophomore crown in table tennis competition.

Having no plans for further schooling, Jim began work as a lens polisher at Briggs Optical Company, but left in 1942 to enlist in the United States Navy as a fire controlman. The next step in his career, after basic training and elementary schooling, was a twenty-one month stay in New Guinea. Hampton was sent to Washington, D. C., by the Navy in 1944 to attend fire control school. It was here at the Navy Department that he met the young lady who became his wife on June 5, 1945.

After receiving his discharge, Jim enrolled in Bliss Electrical School. Here he completed the one year course and then began work for an electrical contractor as an estimator. After two years the desire for more education brought him to the George Washington University in the fall of 1948 to seek a degree in electrical engineering. Hampton joined the AIEE in his sophomore year and was elected representative to the Engineers' Council for the current year. In February of last year, Jim was honored by initiation into Sigma Tau, scholastic honor fraternity of the Engineering School. After being elected to the position of Treasurer of the Engineers' Council, he became a candidate for and was elected to the position of Treasurer of the Senior Class, an office which he is capably holding at the present time.

After graduating this coming May, Hampton's plans include working in the sales department of a firm such as International Business Machines, or Westinghouse Electric.

ALUMNUS



An alumnus who received the George Washington University achievement award in June 1940, was Edwin A. Schmitt, who is one of the outstanding career engineers in the Federal Service.

Mr. Schmitt was born in Washington, D. C., on 6 June 1883, and graduated from the first class of the original McKinley High School. Family financial reverses after he had passed entrance examinations for Cornell University, forced him to seek employment with the Southern Railway Company. From 1903 to 1907 he served in the field on property surveys and spur track layouts. Seeking to complete his engineering education, he transferred to the Washington office of the Railway Company in 1907, where he was an office engineer. He entered upon duty with the United States Engineer Office of the Corps of Engineers in 1910. After many interruptions, due to field trips, he was graduated in 1934. In the meantime, he had passed through all grades of promotion to Principal Engineer.

Mr. Schmitt has been intimately connected with many local development projects of the Corps of Engineers, starting with the old fortifications at Forts Washington, Maryland, and Hunt, Virginia, in 1910. Many River and Harbor projects in the Washington Engineer District have had his guiding touch. Anacostia Park was one of his pet projects for many years. He was connected with the construction of Key Bridge; changes in the river and Columbia Island for the Arlington Memorial Bridge; construction of several miles of the hydraulic fill sections of the Mt. Vernon Memorial Boulevard, and he is the father of the project for the improvement of the Washington Channel waterfront.

In 1934, Mr. Schmitt, in addition to other duties, was placed in direct charge of the Washington Aqueduct water supply system which, since 1853, has continued to supply all potable water to the National Capital and environs. With the advent of World War II, he had charge of all engineering and construction work of the U. S. Engineer Office which, with increasing pressure, was subdivided with Mr. Schmitt remaining in a consulting capacity as Head Engineer, a position he still holds.

With the tremendous growth in population experi-

(continued on page 22)

SOCIETIES AND FRATERNITIES

● The principal business on the March agenda of Sigma Tau was the selection of new members for the fraternity. Final selection having been made, the students concerned will be notified and duly pledged at the earliest opportunity. Initiation, following the pledge period, will take place on the 21st of April.

Acting in accordance with a resolution that the usual initiation banquet be supplanted by a dinner-dance, Jim Hampton announced that plans for such an affair have been completed. This affair, for members and initiates with their wives and dates, will be held at the Lee House, 15th and L Streets, N.W., on the date of initiation. The affair, beginning at 6:30 p.m. and ending at 1:00 a.m., will cost $6.60 per couple. The menu has not yet been decided upon and suggestions should be referred to Jim Hampton. Reservations for the dinner-dance should be placed with Hampton as soon as possible since the number is limited.

● The Student Branch of ASME held its annual student paper competition at the March 7th meeting. Topics and their speakers were the following: "Characteristics of Lubricating Greases" by Robert Curtis, "Mercury-Steam Generation Stations" by Frank Yeide, "Construction Methods for 'Fibre-Glass' Boats" by Robert Harwood, and "Properties and Applications of Titanium" by Charles Jackson. Frank Yeide, winner of the competition, was presented with a six-inch slide rule by the chapter. He will represent the University at the Annual Regional Student Conference of the ASME to be held at the University of Pennsylvania on April 20 and 21. The chapter wishes Yeide the best of luck.

The student branch will hold its election of officers at the April 4th meeting instead as customarily done at the regular May meeting. The change in date was made to enable the incoming officers to acquaint themselves with their duties under the guidance of the old officers, who as yet will not have graduated. Candidates for office should be at the election meeting with their campaign speeches and their supporters. The offices to be filled are chairman, vice-chairman, secretary, treasurer, honorary chairman, and one representive to the Engineers' Council. The other representative to the Council is now elected to office at the beginning of the winter semester in compliance with the new provision of the Council's constitution. Business for the meeting also includes suggestions for the annual outing. Several films will be shown at the conclusion of this business.

● On Tuesday, March 13th, the Student Branch of AIEE attended the Ninth Annual Student Night Dinner sponsored by the Washington Section of AIEE. Approximately twenty-five members braved the wind and rain to be present at the dinner held at the Naval Ordnance Laboratory, White Oak, Maryland.

After being served a delicious roast beef dinner in the cafeteria, the members and guests assembled in the auditorium to hear Mr. Everett S. Lee, a past president of the AIEE, deliver an inspiring talk entitled, "The Young Engineer's Future." "You fellows graduating this year," said Mr. Lee, "have a very bright future indeed. Industry wants you, the government wants you, and General Hershey wants you." Mr. Lee, who for many years has been an executive engineer for the General Electric Company, presently is editor of the *General Electric Review*.

Mr. Frank Crider, chairman of the Washington Section of AIEE, concluded the program by presenting the annual student award of the Washington Section. This award, a year's membership as an associate in the Institute, is given every year to one student from each of the four local branches who has done the most to promote student activities in his branch. Virgil Harris received the award this year for the George Washington University Branch.

Bill Wooldridge will represent the branch in the District prize paper contest to be held at Villanova College in April. The title of Wooldridge's paper is "High Voltage Bushings." He presented this paper at the March meeting and those who attended know he has a fine paper. The branch takes this opportunity to wish Bill the best of luck in the District contest.

● On March 7th, members of the Student Chapter of ASCE attended the annual dinner of the D.C. Section of ASCE at the Officers' Club of the National Naval Medical Center at Bethesda, Md. The regular March meeting was cancelled to permit the membership to attend this dinner.

The guest of honor and speaker of the evening was Mr. Gail A. Hathaway, National President of ASCE. Mr. Hathaway had just returned from India where he represented the United States at the International Engineering Conferences sponsored by India. He spoke on "An Engineer's Impressions of Present-Day India." His observations on construction methods were of particular interest. It was pointed out that in India, as in most of the world, there is a shortage of construction equipment. On one dam, now under construction, there is ouly one-2 cu. yd. concrete mixer. To effect a monolithic pour, a continuous chain of laborers, many being women and children, carry concrete from this mixer in baskets to the point of placement. Aggregate is carried to the mixer in baskets from another point and

is "washed" by dipping the baskets into a barrel of water. Oxen are used on some projects and earth fills are compacted by elephants instead of rollers. Mr. Hathaway continued by remarking on other incidents and describing the general conditions of India. Those of the student branch who attended this affair had only favorable remarks for the dinner and speech.

The speaker at the next regular meeting of the Society, which will be on April 4, 1951, will be Mr. A. T. Goldbeck. Mr. Goldbeck, who is the engineering director of the National Crushed Stone Association, is at present engaged in research in the field of highway materials. He was formerly the Chief of Construction, Bureau of Public Roads, a Professor of Mechanics at Lehigh University, and has been an active committee member in the American Society of Civil Engineers, the American Society for Testing Materials, the American Concrete Institute, and the American Road Builders' Association. His talk will cover the general aspects of research in civil engineering, with special reference to his own experiences in that field.

● Two training films were shown at the last regular meeting of the Institute of Radio Engineers Student Branch of George Washington University, held March 7th in the Hall of Government. One film was on microwave oscillators and the other covered the basic principles of frequency modulation.

During the brief business meeting, plans were discussed for a field trip, to be held in the near future, to visit the Sound Recording Laboratory of the Library of Congress. Exact time and date of the visit will be announced later, and all interested students are invited.

An innovation at the meeting was the presenting of a door prize, which was a radiotron designer's handbook. Coca-Cola, cider and cookies were served as refreshments at the close of the meeting. The next regular meeting is to be held on April 4, and will be in the Hall of Government at 8:15 p.m. All students interested in electronics are invited to attend the meeting. Those interested in becoming members may obtain information on membership at the meeting.

● Theta Tau, the professional engineering fraternity, has just completed its spring pledge season, climaxed by the banquet and dance held March 17. New members are Fred Battle, Bob Burns, Tom Flanagan, John Held, Herman Norwood, Carl Rose, Bob Smith, and Joel Sonnabend. A new pledge class will be formed before the end of the school year.

Among the alumni who were present in such unusually large numbers at the banquet was Julius Ritter. Mr. Ritter, who is a resident of Boston, Massachusetts, made the trip to Washington especially for the banquet and dance. Many past regents were present, including Professor "Deacon" Ames, past Grand Regent, who was personally serenaded by the new members.

Dean Frederick M. Feiker, an honorary Theta Tau, was presented with a gavel signifying his new position as Honorary Regent of Gamma Beta Chapter. At this time, the alumni members presented the chapter with a beautiful birthday cake, in honor of the sixteenth anniversary.

In carrying out the proposed plan of active participation in all-University functions, the chapter is making plans to defend its position as Intramural Bowling Champion. Stiff competition is expected from many organizations, including Sigma Chi, social fraternity and opponent of Theta Tau in the finals of the last tournament, and Alpha Chi Sigma, professional chemical fraternity. Tom Mutchler, who won the individual award in the last contest, has set his sights on a similar goal this semester.

The election of new officers will be held at the first meeting this month. It is to be hoped that the new officers will do as fine a job as the retiring ones who have carried out their duties since this time last year. They are John Lewis, Tom Mutchler, Ed Davitt, and Chuck Plyer.

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(continued from page 8)

type of landing gear as well. As tire sizes become smaller and smaller and the plane becomes increasingly heavier, the tire pressures become correspondingly higher. Two hundred forty pounds per square inch pressure is not uncommon for the modern fighting plane and pressures up to five hundred psi are contemplated although at the present time this is the limit of tire construction.

Larger planes have the advantage of being able to utilize different types of landing gear which reduces the loads transmitted to the pavements. The most prevalent types are dual wheel (two wheels side by side) and dual tandem (two wheels side by side, one pair behind the other). A caterpillar type of gear has been used in some instances but the weight of this gear makes it unsatisfactory for normal use. It is therefore apparent that the small plane with high pressure tires is one of the controlling factors in the design of flexible pavements.

The proper design and type of pavement is contingent upon a number of conditions which have divided the pavements into areas serving a definite purpose such as parking areas, taxiway, warm-up apron, and runway. From the information given before, it can be readily decided what the design criteria should include for the various areas. For instance, the parking area must be of a material that will resist jet blast and the effects of fuel spillage and must be of a thickness sufficient to support the gross weight of the largest plane expected on the field. The taxiway and warm-up apron must also resist jet blast and fuel spillage effects, and should be as thick as the parking apron. The runway, however, is required to support only the weight of moving aircraft and can therefore be reduced in thickness for approximately 75% of its length midway between the ends.

A variety of tests and experiments have been conducted in an attempt to determine all the effects on pavements that may be experienced from jet aircraft. The Bureau of Aeronautics and the Bureau of Yards and Docks of the Navy have performed preliminary tests at the Naval Test Center, Naval Air Station, Patuxent River, Maryland, to study the effects of jet blasts on existing concrete pavements and other special type concrete surfaces.

The Corps of Engineers of the Army has carried out extensive experiments for the Navy at the Waterways Experiment Station at Vicksburg, Mississippi, relative to the effects of traffic with small high pressure tires on asphalt pavements.

The Patuxent tests have not yet been analyzed; however, they are not expected to produce any results with which engineers are not familiar. Joint material melted and blew out of the joints as was

expected but, other than that, no visible signs of distress were noted.

Based on tests and observations at Vicksburg, the following conclusions were made:

a. Traffic of small high-pressure tires has a more deteriorating effect on flexible pavements than large tires or multi-wheel arrangements carrying greater wheel loads.
b. Binder courses used were unsatisfactory in all cases.
c. Satisfactory bituminous pavements can be designed for small 240 psi tires.
d. The design of a satisfactory pavement depends on selection of proper asphalt (or tar) content for a well-graded aggregate.
e. Data obtained from the tests appeared adequate for asphaltic concrete wearing courses but were not adequate for establishing tentative criteria for sand asphalt nor for establishing thickness requirements.
f. Laboratory procedures are not satisfactory since they would not produce densities comparable to those produced by traffic of small 240 psi tires.
g. The effects of parked loads and locked wheel turns were not as severe in these tests as slowly moving loads.

Considerable additional laboratory and field work is required before current criteria could be considered entirely satisfactory for evaluation or design purposes. Answers are still being sought for suitable joint materials for concrete pavements and for proper asphalt content, improved criteria for thickness, and proper densities for asphalt pavements.

CAPACITY-CONTROLLED RELAYS

(continued from page 9)

rectified and the DC voltage is used to control the relay.

In all the capacity-operated relay setups, the sensing capacitor must be located at the site of the object being sensed. Now if the sensing capacitor is connected to the electronic apparatus by a long line, the shunt capacity of the line will be large in respect to the capacity of the sensing capacitor and therefore any change in the capacity of the sensing capacitor will have little effect on the total capacity. It is therefore necessary to locate the electronic apparatus close to the sensing capacitor. The way to solve this problem is to have an auxiliary LC tank circuit at the site of the sensing operation and have this link coupled to the oscillator tank by means of a low impedance, low-loss line.

While the capacity-operated relay is slightly more complicated than the photoelectric cell, it has many more applications in that it senses the approach of an object and does not rely on the object to break a beam of light.

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MOVING TARGET INDICATION

(continued from page 11)

beating with the same local oscillator; since the same local oscillator is used for both mixers, the phase relationships are preserved, even though the absolute phase angles may be changed. Waveforms (a) through (d), Figure 2, represent the steps thus far considered.

Simultaneously with the transmitter pulse, the gate generator in the receiver (see Figure 1) is triggered, and produces a gate which changes the bias of the "coherent oscillator" so as to permit oscillation. The coherent oscillator is tuned to 30 Mc., and is gated on just as the locking pulse signal is applied to its resonant circuit; it is thus shock-excited into oscillation in synchronism with the locking pulse, and is therefore said to "cohere" to the phase of the locking pulse and the transmitter. The duration of the applied gate is just sufficient to maintain oscillation during the receiving period (about 500 microseconds), restoring quiescent conditions well before the next locking pulse arrives.

The intermediate-frequency echo signals from the signal mixer, after some preamplification, may be further amplified and detected to provide normal radar indication, independent of the MTI system. For moving target indication, the preamplified signals are passed through an IF amplifier strip which also limits their amplitude after amplification to approximately that of the coherent oscillator output.

The phase angles of the amplitude-limited echo signals and of the coherent oscillator output are compared in a balanced phase detector. Depending upon the phases of the 30 Mc. signals derived from the individual target returns, relative to the coherent oscillator phase, the video output signals from this circuit may be of either positive or negative polarity, as shown at (f), Figure 2. The manner in which each signal amplitude and polarity is determined by phase angle may be visualized by considering Figure 2(f) as the projection on a plane of vector signals. Because of the limiting action of the IF amplifier, the amplitude of each vector is nearly the same, and the output amplitude is chiefly a function of phase angle.

The phase detector bipolar video output resulting from any one transmitter pulse and its echo returns evidently contains no distinction between fixed and moving targets; the output is a function of instantaneous angles, which are all random in the sense that targets may occur at any distance. However, considering the individual phase angles, in the case of fixed targets these will be exactly the same for every transmitted pulse, whereas for moving targets the associated phase angles will have changed between each two successive pulses. If each train of signals from the phase detector were held over for exactly

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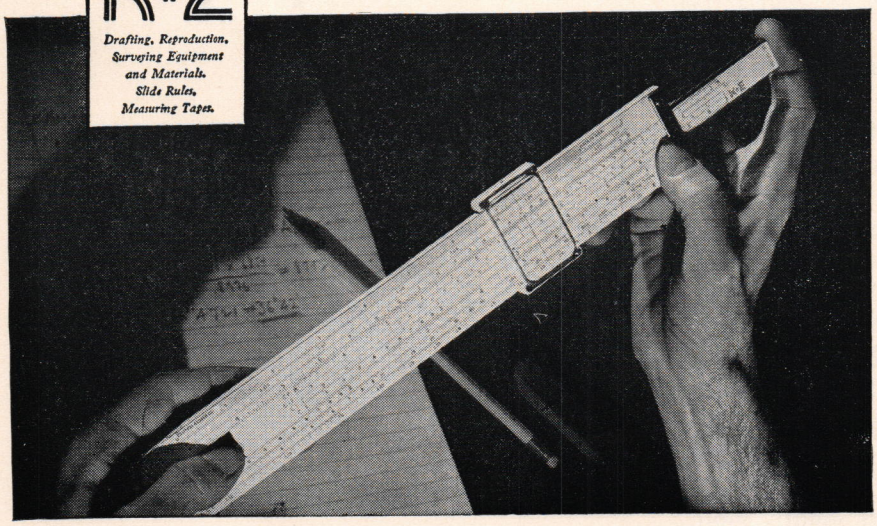

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the period of the pulse recurrence frequency and compared with the next set, the only difference would be found in the signals from moving targets. If this comparison were made subtractively, the fixed target signals should cancel out, while for moving targets the cancellation would be incomplete.

Such comparison process may be accomplished by splitting the phase detector output into two parallel paths, with one channel leading directly to the comparison circuits, and the other passing through a mercury-filled delay line and then to the comparison circuits. The delay line consists essentially of a column of mercury with a piezoelectric crystal transducer at each end; the signal input is converted to sonic waves, whose velocity of propagation in mercury is, of course, much less than electromagnetic propagation velocities; the output crystal reconverts the signals to the original form.

Video signals passed directly through such a delay line may suffer considerable waveform deterioration because of the frequency characteristics of the transducers, and because the propagation velocity is a function of frequency. This effect is reduced by using the video signals to modulate a 15 Mc. carrier, which then passes through both the delayed and undelayed channels, as shown in Figure 1.

The modulated carriers of the two channels are amplified in similar cascade circuits, the gains of which are separately detected and then combined out of phase. Figure 3 shows the detectors and cancellation network. Waveforms (g) and (h), Figure 2, show that corresponding signals in the two detector circuit outputs are exactly equal and opposite, except in the case of moving target signals; hence, when the two outputs are combined, the result should be complete cancellation of all signals except those from moving targets, as shown at (i), Figure 2. Since these uncancelled signals may have either polarity, a bipolar output is again obtained.

A video rectifier circuit is employed to convert the MTI signals to unipolar video, which may then be amplified and applied to the radar indicator in the usual manner.

In the system described, moving target indication is accomplished in three general steps:

1. The phase angle between a reference phase, established by the transmitter pulse, and each target return, is converted to a proportionate video-signal amplitude and polarity.

2. The set of echo signals from each transmitter pulse is delayed in a mercury line so as to exist simultaneously with the next set received.

3. The signals from each two successive pulses are compared subtractively, so that cancellation occurs for all except those derived from moving targets which caused a change of relative phase angle with time.

Hubby: Darling, tell me, how did you ever get Junior to eat olives?

Wife: Simple, I started him with martinis.

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EDWIN A SCHMITT — ALUMNUS

(continued from page 15)

enced during World War II which still is on the upgrade he, with his staff, jointly with officials from the Water Division, the distribution system operated by the District of Columbia, prepared the now famous House Document No. 480 of 1946, which is the bible system—a project which at today's prices will cost for the expansion of the District of Columbia water $68,000,000 to complete. Work on the project is now actively underway, with filter plant extensions, sedimentation basins, pumping stations, etc.

Mr. Schmitt, a life member of the General Alumni Association, was the second president of the Engineer Alumni Association; was president for two years of the Sigma Phi Epsilon fraternity, and took part in the Engineers' Council. He is a committee member of the Interstate Commission on the Potomac River Basin; Chairman of the Coordinating Committee of the National Capital Park and Planning Commission; Vice Chairman of the joint DC-US Water Committee; member of the American Engineering Association; member of the Society of American Military Engineers; Past President of the Chesapeake Section of the American Water Works Association; Member of the Engineers Club of Washington; member of the Maryland-Delaware Water and Sewerage Association. He is both a charter and life member of the Washington Canoe Club.

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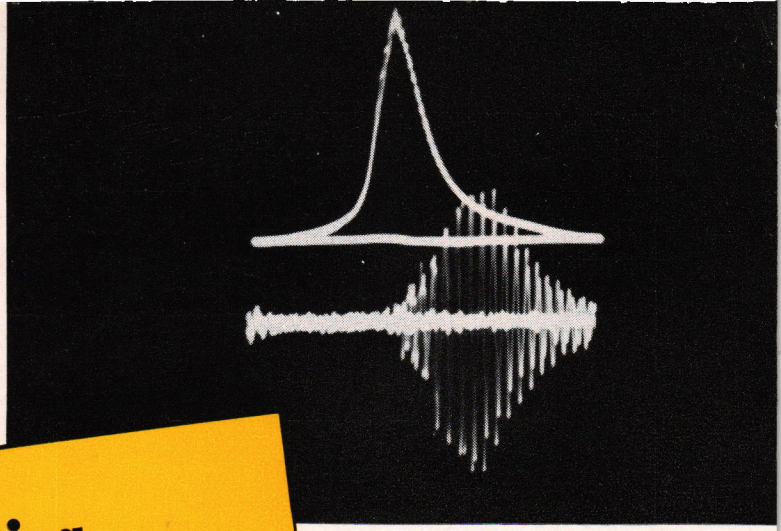

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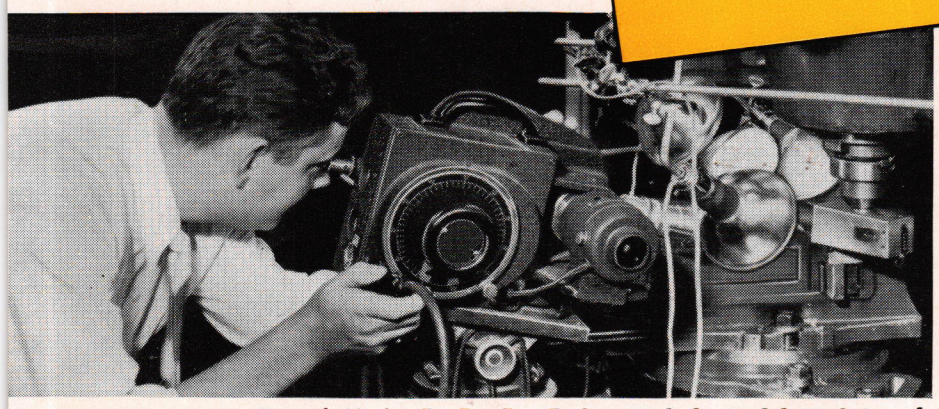

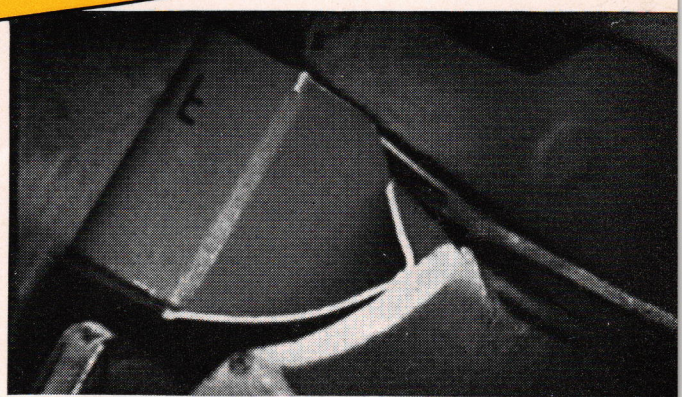

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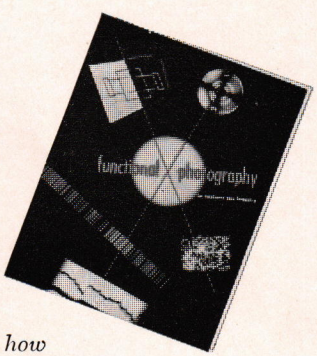

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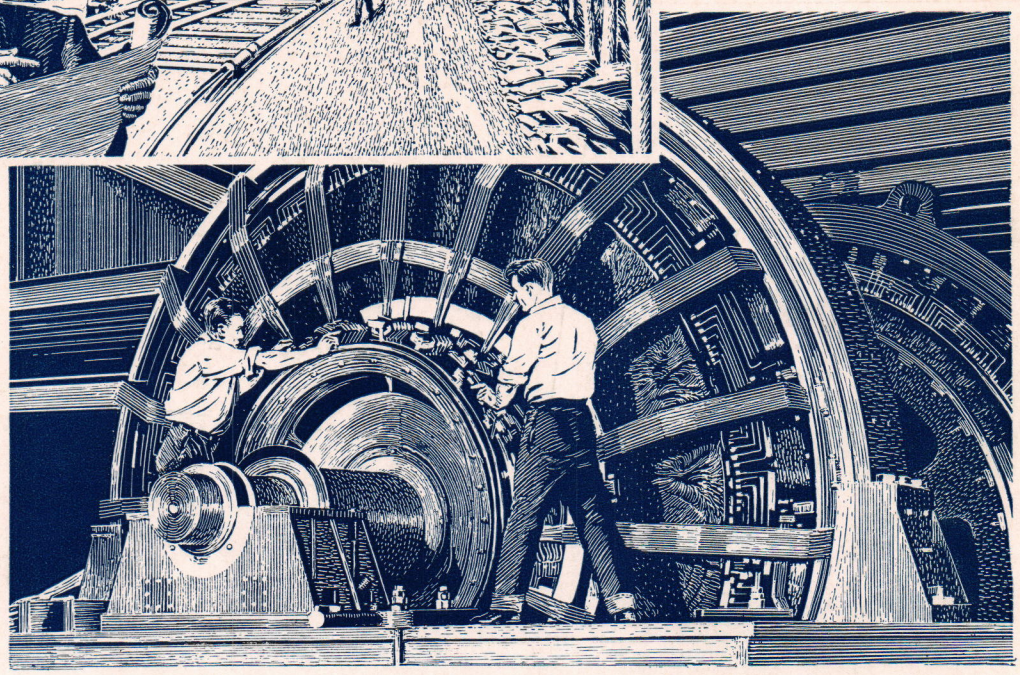

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